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(54) Textile armour

(57) In textile armour to protect against projectiles it has been found that the outer layers slow the projectile down by breaking of the yarn or fibre of the layer, whereas the inner layers stop the projectile by absorbing its energy by fibre or yarn slippage. The present invention provides textile armour in which one or more inner layers is more resistant to yarn slippage than one or more outer layers.

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TEXTILE ARMOUR

The present invention relates to textile armour comprising layers of woven textiles which has improved ballistic performance.

Textile armour, such as a fragmentation-resistant jacket, is commonly made from a plurality of textile layers, typically using about 20 layers of material. The fibres used in the textile of such armour are typically high strength, high modulus fibres such as aramids (aromatic polyamides) e.g. those sold under the trade marks Kevlar, Twaron and HM50, or materials such as nylon, glass, polypropylene, polyethylene or polybenzothiazole. Commonly the fibres are spun into yarns which are woven to give the textile material used.

Such textile armour is generally used to protect the wearer against projectiles such as low velocity bullets and flying fragments. Research has shown that when a projectile is stopped by such multi-layer textile armour, the outer and inner layers function differently in stopping the projectile. In the front or outer layers, the yarn breaks, allowing the projectile through but slowing it down, whereas the back or inner layers act to stop the projectile by absorbing energy and in doing so the yarns slip slightly. When textile armour fails i.e. the projectile breaks through all the layers, this is often due to excessive side-ways slippage of the yarns in the inner layers of textile.

Accordingly, the present invention provides textile

armour for protection against projectiles comprising a plurality of textile layers comprising fibres in which one or more of the inner layers is more resistant to fibre slippage than one or more of the outer layers when the armour is hit by a projectile.

The reduction in fibre slippage in an inner layer can be achieved in several ways:

(i) the inner layer of the textile may be impregnated with a resin; this may be done for example by pre-impregnating yarn which forms the textile, or melting a thermoplastic sheet onto the surface of the layer in which fibre slippage is to be reduced; resins which may be used include: [EXAMPLES OF RESINS]

(ii) compressed felt may be used as an inner layer; this is particularly good at stopping projectiles which are small fragments such as are commonly produced by many modern weapons; a stronger felt, i.e. one with less fibre slippage may be produced by needle-punching the felt, that is to say using needles to draw or push some of the felt fibres across the median plane of the felt;

(iii) inner layer which comprises yarns woven in the usual way i.e. with a warp and a weft may be replaced by a layer in which the yarns are woven in a leno weave; in such a weave the warp yarns are twisted together in pairs between the weft yarns, or the weave contains extra yarns woven

across the warp and/or weft yarns producing a tightly woven textile in which the weave has a locking structure which reduces the fibre slippage;

(iv) the inner layer may be made from nylon which has greater frictional properties than e.g. Kevlar; preferably the nylon yarn is woven tightly so that there is very little slippage.

Textile armour may incorporate several layers whose resistivity to fibre slippage has been increased in different ways.

The inner layers described in (i), (ii) and (iii) above may be made from any fibres known to be used in textiles used in armour e.g. aramids, glass, polyethylene, polypropylene, or polybenzothiazole.

Typically multi-layer textile armour contains about 20 layers of textile material. In such armour in which one or more inner layers is more resistant to fibre slippage, preferably 40 to 60% e.g. 8 to 12 of the layers are of the more resistant type. For example armour may be made from ten layers of Kevlar in front of ten layers of tightly woven nylon. This will give a similar ballistic performance to textile armour comprising 20 layers of Kevlar but is much cheaper to produce and more reliable. The nylon layers may be, say, the ten innermost layers or they may be interleaved with Kevlar layers.

Preferably the inner layers which are more resistant

to fibre slippage allow some very slight movement of the fibres to prevent too great a shock from the projectile reaching the wearer of the armour.

The layers making up the textile armour may be sewn together and armour of this type is particularly suited for protection against low velocity bullets, but it is preferred that the layers are not sewn together if the armour is to be used e.g. to protect against flying fragments.

CLAIMS

1. Textile armour for protection against projectiles, comprising a plurality of textile layers in which one or more of the inner layers is more resistant to fibre slippage than one or more of the outer layers when the armour is hit by a projectile.

2. Textile armour as claimed in claim 1 in which a slip-resistant inner layer is a layer of woven yarns, and is impregnated with a resin.

3. Textile armour as claimed in claim 1 in which a slip-resistant inner layer is a layer of woven yarns which has a thermoplastic sheet melted onto its surface.

4. Textile armour as claimed in claim 1 in which a slip-resistant inner layer comprises yarns woven with a leno weave.

5. Textile armour as claimed in claim 1 in which a slip-resistant inner layer is felt.

6. Textile armour as claimed in any one of claims 1 to 5 in which the fibres of the slip-resistant inner layer or layers comprise an aramid, nylon, glass, polyethylene, polypropylene or polybenzothiazole.

7. Textile armour in which a resistant inner layer is a layer of nylon yarns woven together.

8. Textile armour as claimed in any one of the preceding claims in which fibres of the outer layer or layers comprise an aramid, nylon, glass, polyethylene, polypropylene or polybenzothiazole.

9. Textile armour as claimed in any one o the preceding claims in which 40 to 60% of the textile layers are inner layers of greater resistance to fibre slippage than the other outer 60 to 40% of layers.

10. Textile armour as claimed in any one of the preceding claims in which the layers are sewn together.

11. Textile armour according to any one of the preceding claims wherein the inner layers comprise interleaved layers of higher and lower resistance to fibre slippage.

12. Textile armour according to claim 1 and substantially as hereinbefore described.

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